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MEMORANDUM

To: Robert Law (*de maximis, inc.*)

From: Lisa Saban, Mike Johns, Suzanne Replinger, Thai Do, Windward Environmental

Subject: Passaic Current Conditions Biota Sampling – Lessons Learned from 2019 Sampling Effort

Date: January 30, 2020

This memorandum presents lessons learned by Windward Environmental LLC (Windward) during the 2019 current conditions biota sampling that should be considered when designing the 2020 effort.

SAMPLE NUMBERS FOR TARGET SPECIES

Chemistry data to analyze variability across composites are not yet available. Once they are available, an evaluation will be conducted to determine the minimum detectable difference (MDD) for each species (assuming 80% power and 95% confidence). After this evaluation is complete, changes to the target sample numbers for each species will be considered. The apparent target MDD used by the US Environmental Protection Agency (USEPA) is 0.5. Power analysis of the chemistry data will determine whether the composites collected to date have met the target MDD of 0.5, and if not, how many additional composites will need to be collected during the 2020 current conditions sampling program.

ADEQUATE TISSUE MASS FOR ANALYSIS

The number of fish/crab required per composite to achieve the sample mass needed for chemical analysis was based on the 2009 fish/crab weights. For the 2019 sampling, the mass of individual specimens for two species (white perch and crab) was less than estimated, making it necessary to adjust the number of individuals required per composite. For 2020, Windward recommends the following target numbers to ensure adequate sample mass:

- **Crab** – In 2019, it was necessary to increase the number of crab per composite from three to five. A target of five crab per composite is recommended for 2020.
- **White perch** – In 2019, it was necessary to increase the number of perch per composite from three to four. A target of four perch per composite is recommended for 2020.

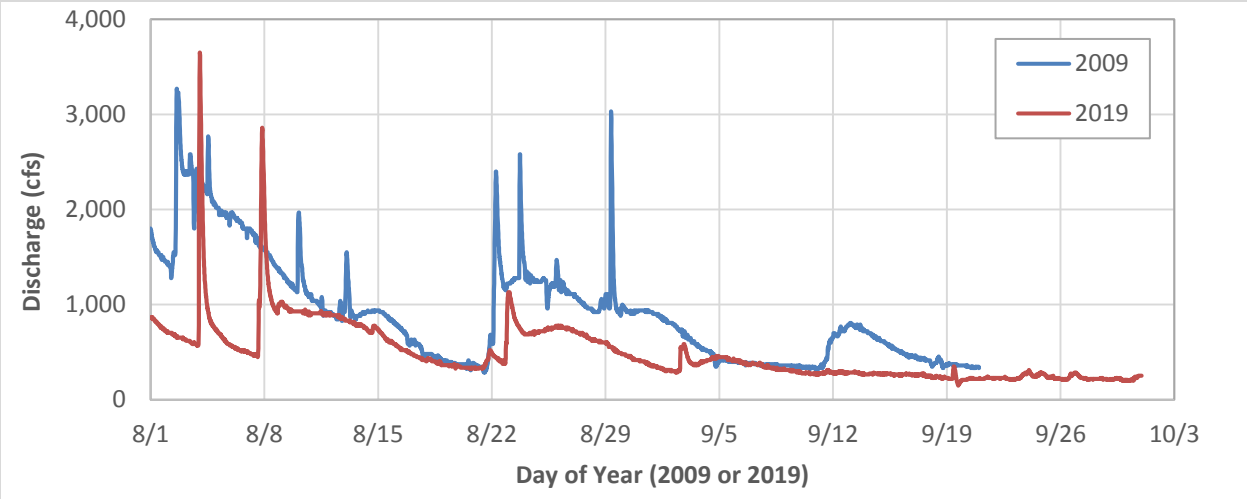
Sufficient sample mass was available for all other target species in 2019, and thus no other changes to the target numbers of individuals per composite are recommended for 2020. As in 2019, American eel, bass, carp, and catfish composites for 2020 will each include three individuals; sunfish composites for 2020 will each include five individuals.

COLLECTION METHODS

Collection methods utilized in 2019 were successful in collecting target numbers of carp, sunfish, and white perch; additionally, the number of bass collected was close to the target number. The actual numbers of American eel, blue crab, and catfish were below target numbers established in the QAPP for the sampling event. For blue crab, the reason for the lower number (compared with 2009) is uncertain. Based on a comparison with catch results from the 2009 sampling effort,[1] it appears to reflect generally low crab abundance in the upper portion of the LPRSA in 2019. This may be related to Lower Passaic River water flows in 2019 (i.e., less than those in 2009) which could have impacted where blue crab were located in the LPRSA (Figure 1). Further, blue crab populations are known to fluctuate annually,[2] which may further explain these differences. While no site-specific data were found for the NY/NJ Harbor estuary, these dramatic changes in stock abundance seen in the region is another possible explanation for differences in catch in the upper nine miles of the LPRSA between 2009 and 2019, even though the same sampling gear and methods were used.

[1] During the 2009 sampling effort, a similar level of effort and methods were utilized in the above RM 8 sampling area. However, more blue crab above 120 mm in length were caught in 2009 (152 crab) than in 2019 (49 crab).

[2] Several examples illustrate this point. First, estimated Delaware Bay blue crab annual abundance has ranged between 29 and 614 million crab (Wong 2009). Second, commercial blue crab landing records for New Jersey (available for 1973 to 2015) indicate that landings are highly variable, ranging from approximately 2 to 5.5 million crab in the 2009 to 2015 period (MBA 2019).



Source: Flows as measured by the USGS gauge at the Dundee Dam in Clifton, NJ.

Figure 1. Flow at Dundee Dam in 2009 and 2019

Recommendations for changes to 2020 collection methods for described below. These changes aim to focus field efforts on the most effective sampling methods (Table 1) and to attempt to better target eel, crab, and catfish:

- ***Eliminate*** beach seining. The main target of beach seining (sunfish) was easily caught using other methods (electrofishing and eel traps). Furthermore, suitable substrate to safely conduct seining generally was not present in the sampling area.
- ***Maximize*** time spent electrofishing. Electrofishing was highly effective at collecting bass, carp, sunfish, and white perch. While it is necessary to let areas recover after each electrofishing attempt, maximizing time spent electrofishing is recommended.
- ***Focus*** time spent deploying and checking traps on more effective trap types:
  - *Deploy* more eel traps. Professional-style eel traps were highly effective at catching both eel and sunfish.
  - *Eliminate* minnow traps. Eel traps and electrofishing were more effective in targeting sunfish (the main target of minnow traps) than were minnow traps.
  - *Deploy* hoop nets to target catfish (in addition to trotlines).
- ***Delay*** the use of gillnets. Use gillnets as a secondary method to collect target species, after first attempting less destructive sampling methods. Crab and catfish—for which gillnets were the most effective sampling method in 2019—will first be targeted using other traps (crab traps and hoop nets, as described above) and trotlines.

Average daily water temperatures during the fish tissue collection effort (September 9 to 28, 2019) ranged from 70 to 73°F. Fish and crab activity is not expected to be significantly impacted at these temperatures.

Table 1. Summary of 2019 catch by collection method

Target Species[a]	Area A (RM 8.3 to 15)						Area B (RM 15 to Dundee Dam)							Most Effective Collection Methods during 2019 Effort
	Crab Traps	Eel Traps	Minnow Traps	Gillnets	Trotlines	Electrofishing	Crab Traps	Eel Traps	Minnow Traps	Gillnets	Trotlines	Electrofishing	Backpack Electrofishing	
American eel		24			2	6		34	1			14	3	eel traps
Bass (smallmouth bass)		2	3	5		70		8		1		36	3	electrofishing
Blue crab	9	3	3	42			1			1		1		gillnets
Carp				2[b]	1	45[b]				0[b]		55[b]		electrofishing, gillnets
Catfish (channel and white catfish)	1		1	27	11	4				12	6	10		gillnets, trotlines
Sunfish (bluegill, pumpkinseed, and redbreast sunfish)		69[b]	18[b]			102[b]		25[b]	5			60[b]	77[b]	eel traps, electrofishing
White perch	1	1	8	18[b]		50[b]				0[b]		77[b]		electrofishing, gillnets

Note: Green shading indicates the most effective collection methods (reflecting both retained and released fish) during the 2019 effort.

[a] Fish collected during 2019 that were excluded from this summary include four largemouth bass, 1 black crappie, 13 rock bass, and 6 brown bullhead. These fish were excluded because these species were not included in any analytical composites.

[b] This summary includes only fish/crab retained for possible analysis. More target-size carp, sunfish, and white perch were collected utilizing these methods (i.e., this summary does not reflect carp, sunfish, or white perch that were caught after sufficient fish of target size had been obtained and agreement had been reached with USEPA to stop collecting these species).

RM – river mile

USEPA – US Environmental Protection Agency